Short communication

Knowledge management in two universities before and during the COVID-19 effect in Peru

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ABSTRACT

Knowledge management evaluation is an important and complex problem in Peruvian universities. An efficient policy in knowledge management is a critical success factor and will also advance teaching and research. Likewise, innovation is a key resource for the well-being of national economies and international competitive advantage, especially with COVID-19 9 restrictions. This research article has demonstrated that an assessment of knowledge management (KM) capability in two private universities could be used for an efficient policy, in order to obtain the best result in knowledge management maturity. Having discussed how to construct a model for KM, the final section of this paper addresses ways of the incorporation of this technology in the society. The case study has been developed in Lima, associated to two universities with 271 teachers and 5928 students; with this model could be used for KM assessment in all university in Peru. This study uses the "Intellectus Model, Mejia model organizational knowledge capability areas and Knowledge Management Capability Assessment (KMCA) model for the assessment, before and during COVID-19. Our findings have demonstrated the university performance and challenges associated to knowledge management during COVID-19, the new policy for virtual instructions and digital transformation of the educational process have improved the cost efficiencies. However, this system also has a number of serious drawbacks and challenges in innovation, researching, connections with industry and academy; this 2021 requires a new perspective in innovation with a knowledge management scheme in Peruvian universities.

1. Introduction

Currently, the Peruvian government through the science and technology organization called CONCYTEC, has created a complex platform for innovation and scientific contribution. However the knowledge management capacity has not been considered in Perú, for the universities development, Melgar A. et al. [1]. Since 2018, the research papers has focus in innovation as the education key for engineering and biomedical science Glass R et al. [2]. We could analyze the evolution of the KM through the education: "Knowledge is considered as one of the key resource of production, a source of sustainable competitive advantage, value and wealth creation" for organizations, "scholars believe that it should be efficiently managed", authors as Nonaka I et al. (2000), define Knowledge Management as follows: KM has a development below two spirals of epistemological and ontological, regardless of the individual merits in education and learning. Furthermore, the author

Rowley [3] stated: "Higher education institutions are in the knowledge business since they are involved in knowledge creation, dissemination and learning. During 2004, the author Enkhbaigali (2004) defines it as: "Deliberate activities taken to handle organizations resources more efficiently in order to improve its performance. Finally, the author Bolorma Demchig [4] defines the following: "Knowledge Management helps companies to stimulate innovation, improve customer services, and achieve business excellence through the accumulation, improvement of availability and accessibility and effective use of knowledge".

On the other hand, in spite of much new knowledge about the role of COVID-19, it is spreading with a high velocity around the world according the authors Arias R et al. [5]; especially in Lima with more than 516,000 cases according Arias Velásques R. et al. [6]; the impact in the public services and universities should be analyzed; in order to obtain an incorporation in spite of the challenge associated to digitization and virtual classes. The knowledge management is the main factor in

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educational institutions. The government pressure in all the Peruvian universities caused by the international accreditation, students requirements, private interests and "expectations of stakeholders such as government, foreign or local employers and students are increasing", according the author Arias Velásques R. et al. [6].

Turning now to the experimental evidence on Universities and "higher education institutions always have to do their business with limited resources of financial and knowledgeable, experienced teachers" according to the author Bolorma D [4]. Knowledge transfer in educational institutes with pandemic condition has a new constraints, additional of challenges detected in the last decade, from support systems according to o Hewitt-Dunas N. (2012) and "dimensions of the intellectual capital: Human, structural and relational" according to Mejía model (Velásquez R [7]).

During the COVID-19, a new approach has been implemented for "knowledge sharing and dissemination mechanism to manage and safeguard knowledge for a competitive advantage through communities of practice", [8]. However, the contribution has not been verified with a real contribution with the virtual technologies and knowledge management during the COVID-19, with a real measurement [8].

In order to provide an overview of the knowledge management in Peruvian universities, before and during COVID-19, we have structured our work as follows: In Section 2, we describe the intellectual capital for knowledge management evaluation, in universities; it includes the objective, methodology of the systematic review with the main theoretical finding and methodologies. In Section 3, we described the results and finding with the analysis in 2019 and 2020, describing in detail output variables as well as the knowledge management net in these two periods. Finally, we finish our research and provide suggestions for future work, in Section 5.

2. Intellectual capital in universities

2.1. Objective of the study

To establish a theoretical framework, model, methodology and tools for knowledge management before and during the COVID-19 in two private universities in Peru; the two largest with teachers associated to the same professionals careers in engineering. This research allows to diagnose the intellectual capital and knowledge management in universities. Designing an instructional "system model for worker education in multicultural and knowledge-based society"; in the intellectual capital based on the Intellectus and Mejia models. To propose actions to implement knowledge management of "learning innovation to increase the workers competencies under multicultural society and sufficiency economy in order to upgrade the life". It has a case study before and during COVID-19 in 2 universities.

2.2. Methodology of study

We have used the methodology PICO for the systematic review, in ScienceDirect, the two algorithm used: (Education) AND ((Knowledge management) OR (KM)) AND (technology); (Education) AND ((Knowledge management) OR (KM)) AND (technology) AND (COVID) NOT (Diabetes) NOT (emergencies) NOT (Korean) NOT (treatment); the results are 55 papers associated to research and review articles on 2020. The main aspects are as follows during the COVID-19:

- During COVID-19, several virtual solutions have been implemented around the world with teleconferencing, videos, however restrictions as "hands-on learning through operative experience" [9].
- Researchers and practitioners have introduced new platforms for knowledge sharing, this agents could help in the transition to digital [10].

- The distribution of knowledge with information sources and verified information is important, however the fake news are not filtered and it generates confusion and low level of knowledge [11].
- Massive Open Online Courses have created opportunities with different types of resources at "anytime anywhere" with students from different countries and with enough storage capacities to store their materials, they "share material content with their peers" [12].
- Mobile learning helps the process by "allowing students to access the learning content on anytime everywhere settings using mobile technologies" [13].
- About the interactions between innovation and human capital accumulation: "Human capital investment should include the establishment of life-long learning systems for workers that help them improve their skills and knowledge to cope with rapid technological change" [14]. In this case, the key factor is the innovation with the combination of skills and knowledge through the learning process.

"It is not possible to control and manage immeasurable things". To increase methods that "try to measure the intellectual capital", it has a big important in the knowledge management. "Making intellectual assets visible has some advantages, as follows: Increasing the stock value, providing the intellectual assets as guarantee, its existence as a bargain element during mergers and determining weakness and strength in the face of rivals" ([15]; p.33). "Each of methods that measure the intellectual capital have various deficiencies and they could be classified under two groups in general. They include methods such as the market value, book value rate, Tobins q rate, calculated intangible value, it is intellectual capital "as a whole, and methods" such as the Skandia navigator, technology broker, value added intellectual coefficient, intangible assets monitor which measure the intellectual capital on the basis of its components Yldz S [16]. The model applied is Intellectus model, according to Bueno E. et al. [17] associated to 2 Universities with 271 teachers and 5928 students, as following:

In the step I, the main information has been studied. The method of this research is a study case, according to author Durany C. (1981), in this case, the qualitative information, social studies, educational programs, among others. The author Merriam (1988) defines the study case as particularised, descriptive, heuristic and inductive stands. This study case has conducted in the descriptive category, which aims to establish the diagnosis of intellectual capital. It has established measures establishing knowledge management. The methodology is based on Model Intellectus according to the author Bueno E. et al. [17]; the methodology for diagnosing intellectual capital for knowledge management requires analysis of intangible assets, it has indicated at Table 2. "To reveal the maturity level of KM in the higher education institution, a survey is conducted adopting Kulkarni and Freezes KMCA questionnaire. At first, questionnaire was translated into" Perú. "Then accuracy and clearness of translation was tested in focus group of 130 lectures and heads". The respondents "placed on each question using a five-point scale (5 Strongly agree, 4 â€" Agree, 3 Disagree, 2 Strongly Disagree, not know/no response)" as an important comment.

2.3. Knowledge management process in the education institute

The main principle is the systemic focus: Everything is just the sum of the parts. This education institute has a process of the educational institution in Fig. 1.

The organization needs more effectively task for the knowledge management process. The creation and implementation thereof shall be based on the intangible according to (Nonaka, Toyama, Konno [18]): Ontological and epistemological principles, it must ensure the learning for the success or failure. The education depends of the knowledge, it has accumulated knowledge and developed the institution. Based on categories and definitions, the author Demchig [4] "based on the model of knowledge management and the model" KPMG Andersen (1999) the
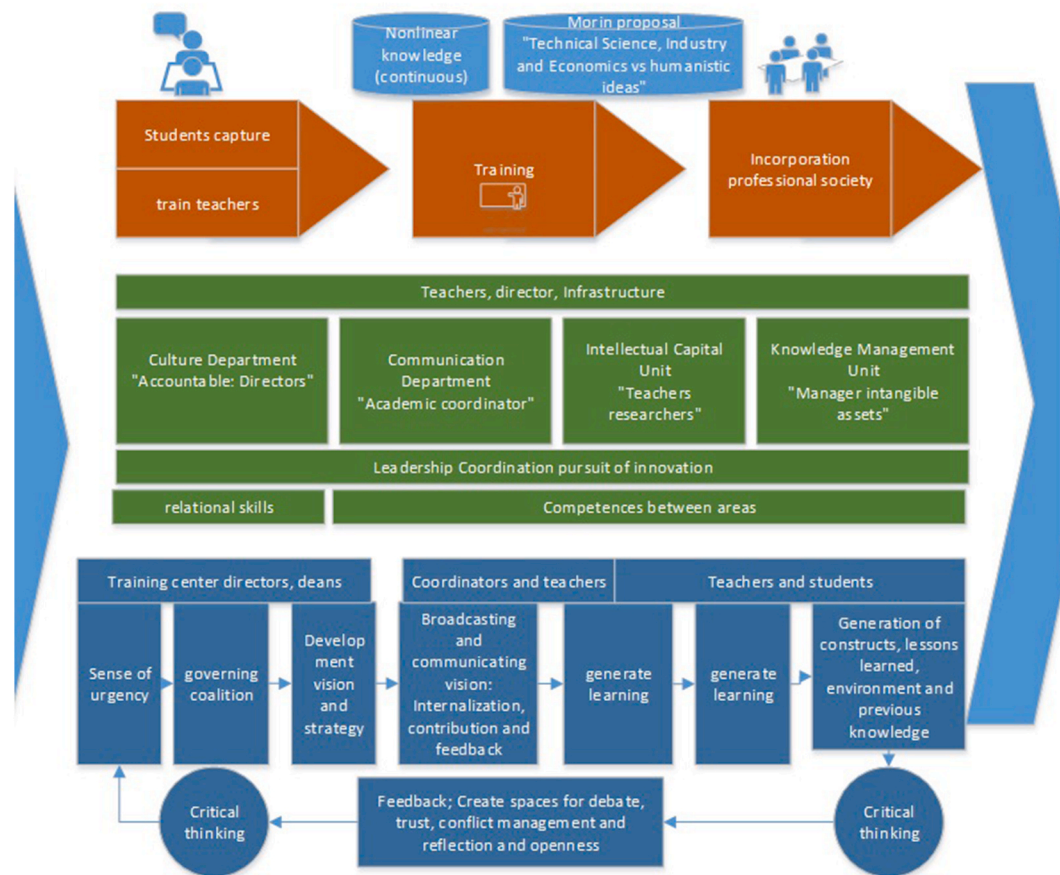
Fig. 1. Complex thinking applied to Universities.

categories:

- Expert Skills: The knowledge is available on the leaders. This knowledge must gain "through experience or formal education. This knowledge" is not easy to express this problem, but it can share with others through group work.
- "Lessons Learned", It is: "Success and failure from similar past projects and are sometimes referred to as best-known-methods according Kelkarni Freeze [19].
- "Knowledge documents", It is: "Explicit knowledge codified for future use according Kulkarni Freeze [19].
- "Data": "Facts or figures obtained from operations, experiments or surveys, stored" in a database for decisions, according Kulkarni St. Louis (2003).

The model for "knowledge management" develops according to the authors Chutiwat, Theeravadee Nuttaporn (2015) as following:

- To explain and guide, it is a step that a coordinator has contacted professors in the field of Higher Education in Computing. To establish common goals, the coordinator and teachers should set common goals and aligned growth strategy.
- To facilitate a process, which is coordinator, teachers provide the support and comfort of sharing knowledge for building teaching. Assign which fits the social network objective, knowledge exchange activity centered on the tactical link - Operating: Teachers and students to bring their own tests for the exchange of knowledge to share opinions among groups. To share and learning, which is related to knowledge exchange activity, the coordinator (Teacher or coordinator teachers) facilitated by the preparation of technology, knowledge sharing and e-learning system.

- Teachers apply knowledge, it creates your own test teaching. The coordinator establishes a knowledge, to exchange activity using Knowledge Exchange and Technology with the support of e-learning system. After then, teachers share their opinions and knowledge with new knowledge and improve overall suitability test. To evaluate, it is a step, the coordinator evaluates their knowledge. The evaluation has divided into 2 parts. It is self-assessment and evaluation group.

Strategies for knowledge management according to author King (2011) are: (1) Coding, implementation of electronic document in the system to encode and store information broadcast. (2) Personalization,

Table 1
Scoreboard for knowledge management in educational center.

Perspective	Measurement index	Assessment
Intellectual achievements	Number of research initiatives based on publications based on faculty members. Category percentage of students in courses of all students	Pending analysis (Regression). Cross-validation (Prediction).
Educational process	Percentage of students passing dropout rate of students in a course before completion.	Ratio (administration). Cross-validation (Regression)
Stakeholders	Level of student satisfaction while gaining academic understanding. Satisfaction level of industry in getting individuals ready and viable in the market.	Ratio (Association).
Intellectual Development	Number opportunities available with the skills. Number of opportunities available for faculty members to research.	Pending analysis (Regression).

focuses on developing awareness among people.

In Table 1, according to Preeti, Deepti T.K. (2014), we can conclude that due to the intangible nature of knowledge, the metrics used to measure it are very different from the common measurements in physical assets. To properly assessment the qualitative areas in the organization, performance indicators are to frame knowledge management based on environment, rather than relying on indicators of technical statistical performance using data mining, they can be incorporated to improve indicators performance and measure the activity of knowledge in the organization. Using data mining techniques, according the author Arias Velásquez R.M. [20]; to measure the activity of knowledge will help unearth patterns and establish relationships between variables that are not visible publicly. Finally, the needs of society and focus, educational institutions require a strategy, according by Whyte (2008), it has responded a vision based "planning and action to achieve the best results with the least" effort possible and profitable level of people, equipment, time.

3. Results and findings

This instrument allows the evaluation of "the current perceived state and context of the focus" in the university associated to the knowledge management, associated to 2 universities with 271 teachers and 5928 students; before COVID-19 in 2019 and during COVID-19 in 2020, as following:

3.1. Step 1. fundamental information

Holgersson et al. [21] and Intellectus Model by Bueno E. (2011) determine the level of intellectual capital or knowledge management for corporation or institutes, with Technology transfer offices and their management procedures. For this study case, Intellectus Model will work with 23 variables, grouped into 13, 7 and 3; for Intellectual capital diagnosis. For the questionnaire, it has evaluated by Cronbach's alpha with good results inside the reliability values [24], it allows to use the model for new evaluation in others educational institutions in Perú, it has the followings results:

Human Capital. For this study case, the knowledge for human capital, skills [25], values [26], attitudes and capacities through 13 variables, Fig. 2. The minimum level indicated in the knowledge management analysis, was obtained according the evaluation of the steering committee of both universities before this study.

Structural Capital. For this study case, the knowledge for structure capital, sharing culture, structure, process and organized learning in organizations [27], through following variables: Culture, Structure, process and organized. At Fig. 3 the lowest items are: The work environments at university is stressful teams and employees tend to higher educations and organization learning, because there are not procedures to disseminate lessons among teachers.

In Fig. 2, the main impact during COVID-19 is the employees tend to higher education: The adaptation of the new reality with quarantine period and the new technologies with more work has new challenges; therefore, the teachers donÁ't be agree with the plan of external training; besides, in both cases the universities don't provide conditions for continuous learning and training. Just for digital transformation but not for the courses [22]. On the other hand, the loyalty and commitment of the universities are remarkable with the success during the COVID-19, because a new role was prepared with continuity during COVID-19 quarantine and new reality without physical infrastructure [23].

Before COVID-19, In these institution, the 47.5% of teachers believe

Table 2
Reliability statistics.

Cronbach's alpha	Number elements
0,914	222.

that knowledge is socialized, there are information on the educational processes pending to disseminate, it has reflected by the lack of planning and regulation that promotes the generation, dissemination of knowledge within the organization. So partly relation expressed by the author Bueno E. et al. [17]; they define the work environment as "capacity of the organization to acquire new skills and knowledge in order to respond to the dynamics of organizational change and development" According to this Model, this educational institute has a weakness for to disseminate the new knowledge.

During COVID-19, the Peruvian universities have sought institutional strengthening in structural capital; about the 89% of teachers and students know about the institutional educational project with COVID-19 restrictions; so, the 42% of teachers and students think about the cooperative atmosphere in the organization; finally, a strength of institutions are the organizational learning during COVID-19, due to a large database with courses, labs test and students; with this platforms it allows an organizational learning with 61%.

Relational Capital. For this study case, the knowledge for relational capital, relations with internal process and shareholders through 3 variables: Distribution channels, the organization relationship with suppliers, customer satisfaction [23].

The organization's reputation and image, marketing skills. Customer service marketing skills, the organization relationship with customers. The minimum level is customers satisfaction; it has relation with parents loyalty with the institution, it is demonstrated at Fig. 5.

Before COVID-19, in these institutions, the 60.0% of teachers are agree with the channels of communication with parents in the organization. In the Strategic Plan, the institution has a system of fluid communication, open and oriented institutional purposes; however, all corresponding channels are not specified in the educational institution process. This relates to the statement by the author Bueno E. et al. [17] who defines satisfaction customers as "Volume and quality of relationships and business information held with the shareholders and investors of different financial stable character in the company".

During COVID-19, the relational capital is the most affected; the parents and students are not loyal to the organization, about the 40% has an intention to participate in continuing education in the second semester of 2020 and 2021, because the benefits of the university are not possible in this new reality: Student exchanges, professional practices, congresses, seminars and laboratories, etc.

3.2. Knowledge management process in the education institute

"Step II The instructional system design was developed". They included: With the actual approach in Fig. 5, the model proposes a knowledge net to generate knowledge inside the educational institute. With the information, it permits describe some leaders in the educational institutes, there are 7 groups, they have divided into 3 communities.

It permits a "multi-level analyses, collecting and storing data suitable for multi-level analyses takes information from a static snapshot towards richer, more dynamic knowledge, enabling more reflective questions to be answered" [28]. "An example of such a question might be: from the time a particular cohort of students" strayed at private universities, which groups show increasing success and which groups show a decline in achievement? In particular example in Fig. 5 it shows the groups of teacher with leadership in the knowledge management.

IC assessment is a practice is "poorly studied so far", according to Ross et al. (2005). "From the point of view of IC theory development, the most significant contribution to this field" belongs to Bontis (2001) and Andriessen (2004), "who have made in-depth comparative analysis of more than twenty IC" [29]measurement methods. IC assessment "leading to their classification into two groups: Methods for internal IC management and methods for the external IC" [30] disclose. With Intellectus model, it permits internal and external IC. "Based on the literature review carried out Table 2 and the questions reflecting the key
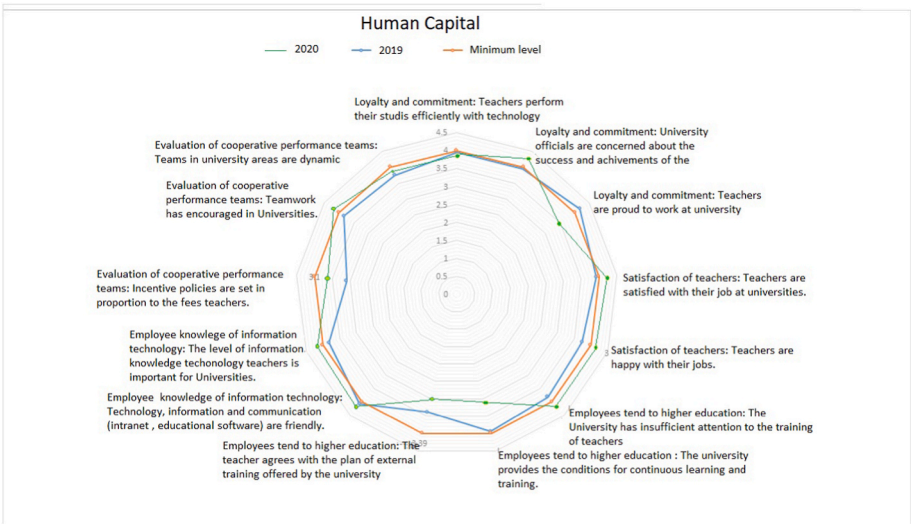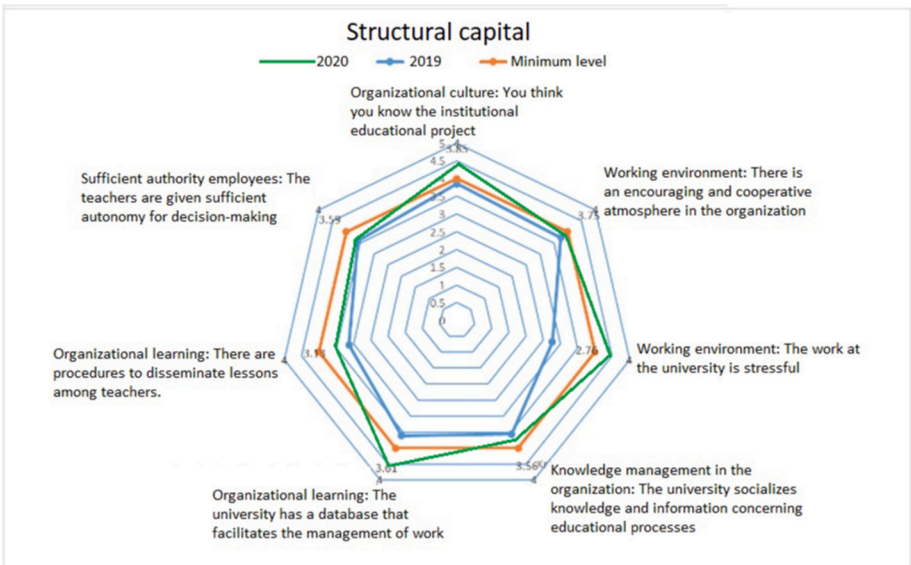
Fig. 2. Human capital assessment.

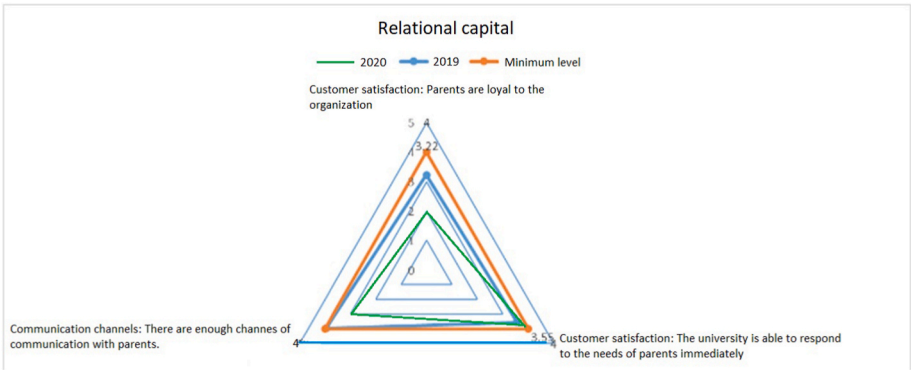**Fig. 3.** Structure capital assessment.

Fig. 4. Relational capital assessment.

aspects relevant to IC measurement practices identified, the conceptual model highlighting the variety" [31] of relationship between influencing factors and IC measurement practices as well as opening areas of potential research is suggested. After in-depth discussion of the model, its empirical verification has been executed. In the initial stage of research, the study case carried out with a principal university at Per,
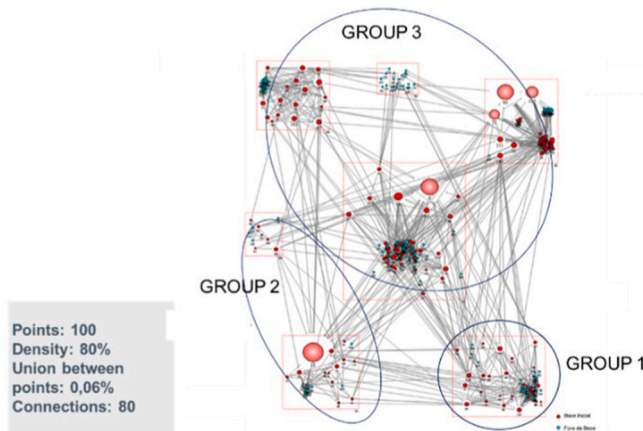
Fig. 5. Knowledge Management net.

Fig. 7. Comparative analysis: Connection and nodes during COVID-19.

the maturity has been calculated to each capital: Human capital (3.85), structure capital (3.73) and relational capital (3.34), it permits a IC measurement "practices or going deeper into the smaller-scale research on particular factor or a couple of them the surveys could be employed next to the case studies" [32].

For the same number of teachers, students and connections before and during COVID-19, a greater number of connections have been seen demonstrated in comparison Fig. 6; with 271 nodes and 227 connections. However, during COVID-19, the connection is 575 with relation of 2.122, as Fig. 7; it is 2.5 times better than last year, as part of structural capital, however the capacity of the institutions does not allow to improve knowledge management, considering capital relational.

In Fig. 7 in 2020, the density is 0.843%; it is more than 2.81 times than 2019.

According Figs. 7 and 4, these universities need to analyze the environment and capture knowledge that leverages improvements and new business opportunities nationally and internationally. Generate intellectual production and actively participate in events, sector forums and any other space, with the purpose of enhancing knowledge and contributing to evolution.

Besides, in Figs. 2 and 3, these universities generate knowledge and innovation seeking to leverage competitiveness, and to promote the generation of knowledge by seeking access to appropriate technologies for the development of the business value chain processes, in order to guarantee that the knowledge complies with the different stages of its management cycle. Likewise, to promote the exchange of knowledge with suppliers in order to manage and/or contribute to their
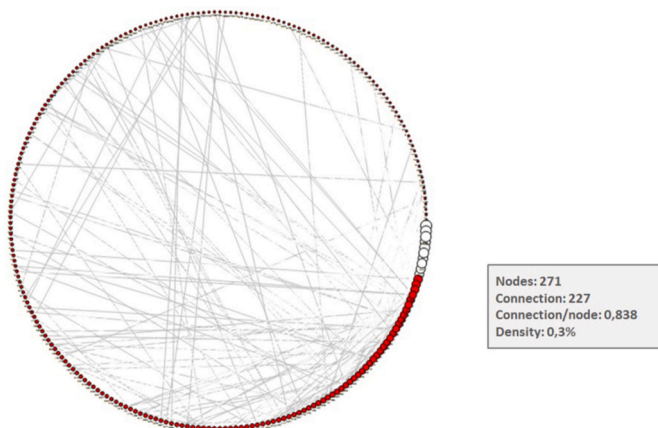
development and leverage learning opportunities. The relational capital has challenges in the role of governance as follows:

- The director should assign roles, responsibilities and ensure compliance with procedures for knowledge management.
- Universities should Provide the structure and resources necessary for the development of knowledge management.
- Universities have the physical and technological infrastructure necessary to facilitate interaction and learning [33].
- Systematically monitor and evaluate the resources, processes and results of knowledge management [34].
- Prioritize critical knowledge and ensure that it is continually developed in the knowledge management cycle.
- The university should ensure the continuity of the identification and prioritization of critical knowledge [35].
- The university would align the learning agenda with critical knowledge in order to leverage the development of this knowledge and comprehensively manage Knowledge, Organizational Learning and Innovation [36].

4. Conclusions

This research article has demonstrated the contribution from data to knowledge increment, through the measure levels of "knowledge management capability" and "maturity". A real case study with two universities of Perú before and during COVID-19, allows to identify the knowledge management maturity and constraints because of COVID-19, for new policies and improvements. An interesting result reveals the level for each KMAs using Intellectus Model (2011), KMCA model and Mejía model according Velsquez R et al. [7]; before and during the COVID-19. Before proceeding to examine KM, it will be necessary to apply a survey, about the "subjective or qualitative statements" about universities knowledge management maturity level.

This instrument introduces valuable information of the knowledge capabilities to the University managers, the main contribution as follows:

- The best understanding about the organizational knowledge management capability maturity.
- To introduces some set of components and results "expected for each maturity level when knowledge management" [34] involves to the university.
- To generate the answer about "how it can advance to the next level"[33].
- COVID impact in the knowledge management and new constraints.
- The knowledge management improvement.

Fig. 6. Comparative analysis: Connection and nodes before COVID-19.

The assessments permit to recognized the knowledge management net, with the real interactions and get a better interaction with capitals: Human, structure and relational, it permits to achieve improvements in the educational institute.

The COVID-19 has caused a great problem in the digitization and management of knowledge, universities have had to adapt quickly to respond to the services they provide. The first step allows to develop the human capital in 2020–2021, and structural capital, however, the relational capital has been degraded with a lower performance than 2019. Although the level of connections has increased, institutional relations, work with other institutions and companies, have decreased according Fig. 4.

Finally, the results of this research article could serve as a procedure and methodology in high education, research for coping with issues to measuring Universities performance. Such an approach allows a dynamic network technique. "It also hoped that the models and methods used in this study can bring about other related research" in other platforms as high school or private companies. The research has developed the data as a generation of knowledge for improvement the management in high education and "suggested a more in-depth cohort approach for the analyses of universities data". COVID-19 has changed the way to teach in our universities, they need new parameters to evaluate the evolution, in future works we strongly recommend the study of knowledge management associated to digitization parameters and innovation stages. The digital university has more benefits than traditional institutions, however, the contribution of the relational capital should be considered in the impact of the students future.

Author statement

Ricardo Manuel Arias Velásquez: Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Resources; Software; Supervision; Validation; Visualization; Roles/Writing - original draft; Writing – review & editing. Jennifer Vanessa Mejía Lara: Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft, Writing – review & editing.

Declaration of competing interest

There is no conflict of interest in this work.

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